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ABSTRACT

The paper uses a case study of a 10-year-old hearing impaired child to describe an articulation program for the hard of hearing which is characterized as a multiphonemic, sound/symbol, expressively-based approach. Reviewed are the Multiphonemic Sequencing system's six major components: target phoneme selection, associations, synthesis, analysis, phoneme additions, and expanded constructions. (CL)

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AN ARTICULATION TREATMENT
PROGRAM FOR THE HEARING IMPAIRED

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Unintelligible or partially intelligible speech with otherwise adequate oral communication skills is not an atypical finding in groups of "oral" hearing impaired individuals. To have oral communication skills which are fully negotiable within the larger, normal-hearing community, however, requires that all aspects of speech and language be acceptable. Not only are speechreading and grammatical skills

required, articulatory competence also must be demonstrated. This need for acceptable articulation mandates the continued development of new management programs as well as the refinement of traditional programs.

This paper will present an articulation treatment program for the hard of hearing using a case study format. Mike, the child to be presented, was first identified as profoundly hearing impaired at twenty-two months of age. He subsequently was enrolled in an oral preschool for the hearing impaired at the John W. Keys Speech and Hearing Center, Oklahoma City. In addition to his formal instruction, a comprehensive home program was implemented by the family.

At eight years of age, Mike was placed in a regular second grade classroom in a private day school. In addition, he has continued to be seen at the Keys Center for tutoring in academic subjects. Mike has functioned extremely well, both socially and academically, with this program.

At the time of his most recent audiologic evaluation, on January 10, 1975, Mike did not respond to pure tones bilaterally by either air or bone conduction. Speech detection thresholds were not obtained at the maximum output of the audiometer.

Mike was fitted at twenty-two months of age with a unilateral body aid which he continued to wear until January, 1975, when he was fitted with an over-the-ear model. He has rejected this aid within the past year, saying that he receives little benefit from it.

In 1975, an extensive battery of tests was administered which verified earlier findings. Mike's non-verbal intellectual abilities are at the upper limits of the normal range. Academic skills, including

reading, are at or above grade level. Although both spoken and written expressive language contained morphologic and syntactic errors, they were judged to be above average for a person with this degree of hearing loss. Speechreading abilities were judged to be well above average.

Despite his many areas of strength, Mike's spontaneous speech was essentially unintelligible following eight years of traditional management. Because of his markedly decreased intelligibility the articulation management program to be reported was initiated when Mike was ten years of age.

METHODOLOGY

The first step in devising a management program for Mike was to obtain baseline data utilizing a phonologic analysis which allowed the derivation of his rule system. This analysis indicated that Mike was able to produce many, though not all, English phonemes. He did not demonstrate, however, the standard structure or system for sound combinations in English; that is, he lacked the usual phonologic rule system. Indeed, it was possible to prove the existence of only two phoneme categories, labial and lingual. Within both the labial and lingual categories, all sounds were interchangeable. Thus, the word "to" could be produced "ko," "do," "goo," etc., and the word "bow" also could be realized "po" or "mo." Labial and lingual consonants were not interchangeable.

Following this initial analysis, it was determined that any management program should present the contrasts and speech sound sequences necessary to provide Mike with a more appropriately organized phonologic rule system. Further, because of Mike's age and his dependence on oral communication skills, an approach which would facilitate rapid progress was desired. Finally, Mike's profound hearing loss dictated an approach which relied extensively on visual input.

To meet these needs, it was decided that five elements should be emphasized in Mike's articulation treatment program:

- a. multiphoneme presentation,
- b. multifeature presentation,
- c. sound/symbol/feature association,
- d. sound/symbol/feature sequencing, and
- e. real-time analysis.

The Multiphonemic Sequencing (MPS) program was selected because it incorporated three of these elements and readily could be modified to include the others. The MPS program, a multiphonemic, sound-symbol, expressively-based approach had been developed and utilized clinically over a number of years at the John W. Keys Speech and Hearing Center. During those years, it had been found to be particularly effective with clients presenting moderate and severe articulation disorders, but who were stimuable for phonemes in isolation.

The strong visual component of the MPS program and its stress on phoneme sequencing skills made it particularly appropriate for use with Mike. Additionally, the emphasis on self-correction and self-monitoring skills greatly increased its efficiency, particularly in promoting generalization beyond the treatment session.

MAJOR COMPONENTS OF THE MULTIPHONEMIC SEQUENCING PROGRAM

The Multiphonemic Sequencing program includes six major components or steps: target phoneme selection, associations, synthesis, analysis, phoneme additions, and expanded constructions. Each of these components is described in detail below along with the modifications designed to maximize Mike's strengths.

Target Phoneme Selection

The first step in the MPS program is the selection of target phonemes. Stimulability is the major criterion for selection rather than other factors such as developmental order. Initially, three to six stimutable consonant phonemes are chosen which readily may be combined with vowels to form a number of consonant-vowel-consonant (CVC) units. For Mike, it was necessary first to teach the production of some target phonemes before inclusion in the program.

Associations

In the second step of the standard MPS program, the following four associations are established for each target phoneme:

- a. the auditory production,
- b. the visual form,
- c. an onomatopoetic picture, and
- d. a representational name for the picture.

If the target phoneme were /t/, for instance, associations would be established for the spoken form, the written form, a picture of a clock and the descriptive title "the clock sound." Associations must be well stabilized among these factors and, given one association, the client should be able to cite the others with ease.

In utilizing this program with an older, profoundly deaf child, such as Mike, the associations, of necessity, are modified. The most critical alteration is necessitated by the client's inability to use auditory cues. He must rely on associations between the tactile-kinesthetic characteristics of the sound and the visual form obtained from speechreading. In addition, the pictures and sound-name associations are eliminated.

Ordinarily, when two or more written forms may conventionally designate a phoneme, one arbitrarily is selected for use in establishing the association. The graphemes "s" and "k", for example, consistently are employed to designate the phonemes /s/ and /k/ to avoid the confusion of variable visual representations. Thus, the word "cat" would be presented as "k - t" and the word "face" would be presented as "f - s." Since Mike had an established written system, both standard orthographic and phonetic forms were presented; that is, both "face" and "f a s" would be shown.

The standard MPS program also was modified to include distinctive feature concepts to facilitate generalization across phonemes. The distinctive features of a sound are those aspects of the sound's production which serve to differentiate it from other sounds. For example, /t/ and /d/ both contain the features tongue tip-alveolar and plosive; the feature of voicing serves to differentiate them. Similarly /t/ and /s/ have the features of tongue tip-alveolar and voicelessness in common and differ in their manner feature, the first being plosive and the second fricative. The phonemes /k/ and /s/, in contrast, differ by three features: place of articulation, manner of articulation and voicing. Although more complex distinctive feature systems have been proposed, the traditional features of articulatory phonetics were utilized in this program because each could be demonstrated and explained. Mike experienced no difficulty in learning tactile-kinesthetic aspects of these features.

Modification of the standard MPS program also included the use of a real-time visual display for selected phonemes to provide additional visual cues. This involved the presentation of a visual display of selected acoustic wave features simultaneously with sound production.

An oscilloscope was used as a visual monitoring device until the tactile-kinesthetic patterns of the phonemes were established both in isolation and in monosyllabic words. Thus, the real-time display was utilized in the association stage as well as the two following stages, synthesis and analysis.

Once Mike was able to produce a phoneme correctly, he utilized the visual display of his own production as a reference or standard rather than matching the clinician's production. After tactile-kinesthetic patterns were stabilized, Mike's sound production became independent of the visual display without prompting from the clinician.

After the above modifications were introduced into the MPS program, the following associations were required of Mike:

- a. the "auditory" production as perceived through speechreading,
- b. the visual (written) form,
- c. the articulatory features of place, manner and voicing, and
- d. the real-time display for selected phonemes and/or features.

Synthesis

Within the MPS program, the process of synthesizing CVC words is begun when associations have been established for three or more consonant phonemes. Consonant phonemes in the CVC words are limited to those for which associations have been established. Throughout this stage and the next, it is imperative that the stimuli consist only of words in which the client is able to articulate all sounds correctly.

The written symbol for each consonant phoneme is displayed on an individual card. Vowels, for which associations typically are not established, are represented by a dash. CVC words containing silent letters

in their graphic forms which are not represented in their verbal forms may be utilized, but unrealized letters are not presented.

The individual cards with their written symbols are presented in a left to right sequence by the clinician. Simultaneously, the auditory production is elicited with the clinician providing the appropriate vowel. The cards are initially placed with considerable distance between them, the visual spacing corresponding to the temporal spacing between auditory productions. This sequenced production is repeated several times until a blended, synthesized CVC word is produced. When the blended production has been achieved, the client selects an appropriate picture to emphasize that a meaningful word has been articulated.

If the client makes an error at any point, the clinician should return to an earlier step in the MPS program. This might entail returning to the association level if the client produces an incorrect sound or increasing the auditory and visual lag if the error involves synthesis.

If difficulty is encountered in this step, the introduction of continuant phonemes in synthesis activities has been found effective. In addition, the clinician might introduce CV's or VC's until the blending process is mastered and then re-introduce CVC combinations. CV's and VC's also may be utilized for some vocabulary variety, but two-phoneme units should not be relied on extensively.

To the extent that co-articulation phenomena are phonetically conditioned, they will not be evidenced in the early stages of synthesis. With normally hearing children, co-articulation usually appears spontaneously in latter stages of the program without specific training. Mike, however, frequently required specific instruction.

Analysis

When synthesis has been stabilized for several consonant phonemes, the process of analysis is introduced. At this stage, the clinician presents a synthesized CVC and the client is asked to identify and produce its component phonemes. Following analysis, all CVC's are immediately synthesized.

Successful learning of analytic skills is critical in enabling the client to self-correct and to generalize correct articulation beyond the specific units practiced within the MPS program. This stage, however, usually requires less time than synthesis and the client encounters less difficulty.

Phoneme Additions

When the client successfully has completed the association, synthesis and analysis stages with the initial group of phonemes, a new set of target consonants is introduced at the association level. Associations first are established and these new phonemes are added to the initial set of phonemes. This entire pool of phonemes should then be utilized in both synthesis and analysis activities.

Expanded Productions

The introduction of phrases and sentences allows the client to develop more complex sequencing skills and permits the utilization of non-picturable words such as conjunctions and articles. It is useful to initiate the level of expanded productions with structured phrases and sentences in which only a single unit is rotated. Thereafter, the number of different sentences and grammatical structures is gradually increased.

During early activities with expanded productions, the client is presented with units containing only phonemes which can be articulated correctly and for which visual representations always are utilized. This phonemic control becomes less feasible as the phrases and sentences become more spontaneous and the visual representations are gradually reduced at a pace conforming to the client's decreasing dependence on external cues for correct productions.

Although polysyllabic words are not included specifically in the MPS program, they do appear in more spontaneous productions. Clients usually are able to generalize correct production to medial position in polysyllabic words and seldom require specific instruction. If errors do occur on the medial consonants, however, the correction procedure is the same as with monosyllabic words.

EVALUATION OF PROGRESS

After the baseline articulatory assessment on May 30, 1975, phonologic analyses were undertaken at regular intervals. Figure 1 presents a comparison between Mike's original articulatory performance and his current status as determined on April 5, 1978, averaged over word positions. The data are presented separately for initial and final word positions in Figure 2.

Although Mike's consonant articulation is obviously not within normal limits at the present time, considerable improvement can be observed. The most striking change is a general increase in the consistency of correct production of sounds which were present in his baseline inventory. In addition, the total number of phonemes has increased, primarily in the nasal and fricative categories. Both the increased consistency and the greater number of phonemes have contributed to Mike's significantly improved intelligibility.

The following specific observations are demonstrated by the data presented in Figures 1 and 2:

- a. The percentage of correct production has increased for most phonemes or remained unchanged. Exceptions to this generalization are /p/, /b/, /d/ and /g/.
- b. Nasal and fricative consonants have demonstrated the most significant improvement.
- c. Within the plosive category, /t/ and /k/ show considerable increases in the percentage of correct production and /n/, /b/, /d/ and /g/ have decreased. This trend is most evident for /b/ and least evident for /g/.
 - 1) For the phoneme /p/, there is a slight decrease in correct production which is essentially equal in initial and final word positions.
 - 2) For the phoneme /b/, decreases in correct production primarily are accounted for by word-final errors. The difference in initial position is negligible. All errors involved substitution of a nasal continuant consonant.
 - 3) For the phoneme /d/, an increase in correct production can be seen in the word-initial position while a significant decrease in correct production is noted for the word-final position. Errors primarily are those of continuant sound substitution.
 - 4) For the phoneme /g/, a substantial increase in correct production is seen for word-initial position and a substantial decrease is evidenced for word-final position. Final position errors principally are errors of omission.

- d. Those sounds which were not produced or which occurred only minimally at the time of the baseline testing demonstrate the greatest improvement. Conversely, those sounds which were used most frequently at the time of the baseline testing, both correctly and as substitutions for other sounds, show the least improvement. This might lead one to speculate that sounds which were never used in a relatively unstructured phonologic system are more easily incorporated into a rule-operated system than are those which were used more or less at random.
- e. The following sounds are not included in the data: /h/, /r/, /ʃ/, /tʃ/, /ʒ/, and /dʒ/. Mike has been unable to consistently differentiate these sounds on a phonetic level.

CONCLUSION

An approach to increasing the articulatory proficiency of a profoundly hearing impaired child has been developed and utilized over the past three years. While no procedure has general applicability to the population of hearing impaired, the approach developed appears to be effective with selected clients and, as such, warrants inclusion in a clinician's repertoire of articulation management techniques.

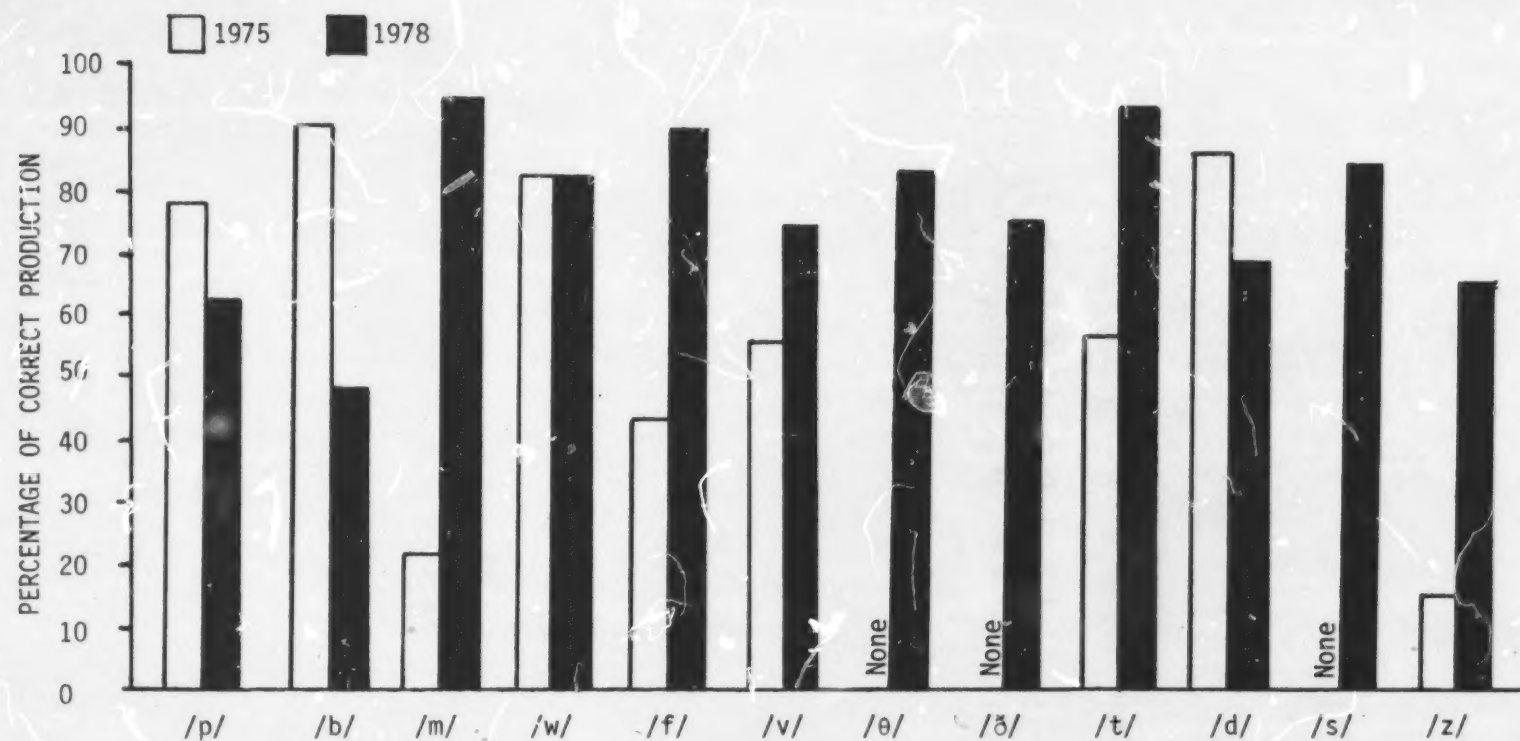
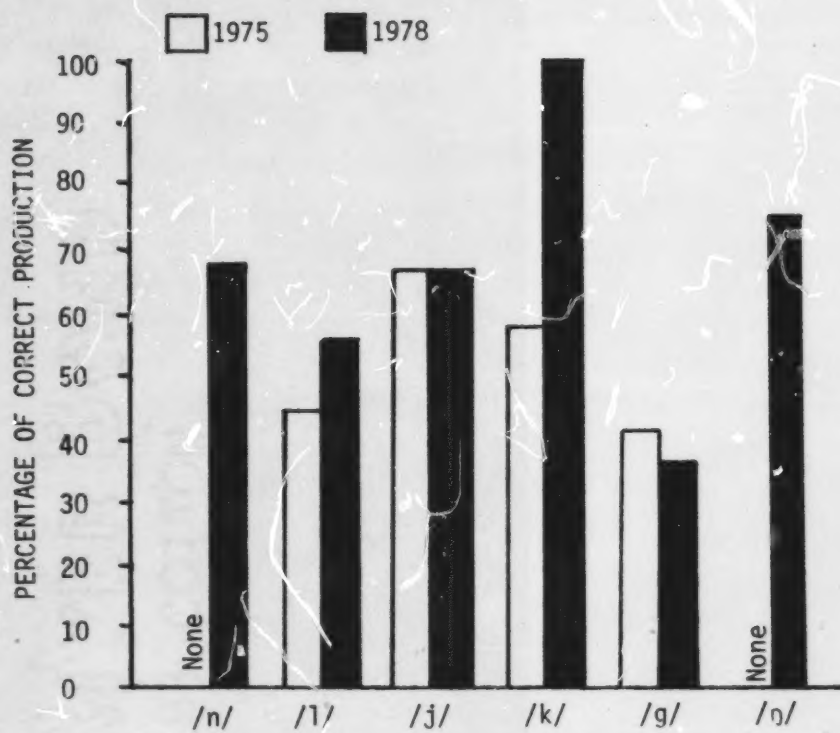


Figure 1. The percentage of correct production of phonemes in 1975 and 1978. Word-initial and word-final percentages are combined.



(Figure 1. Continued)

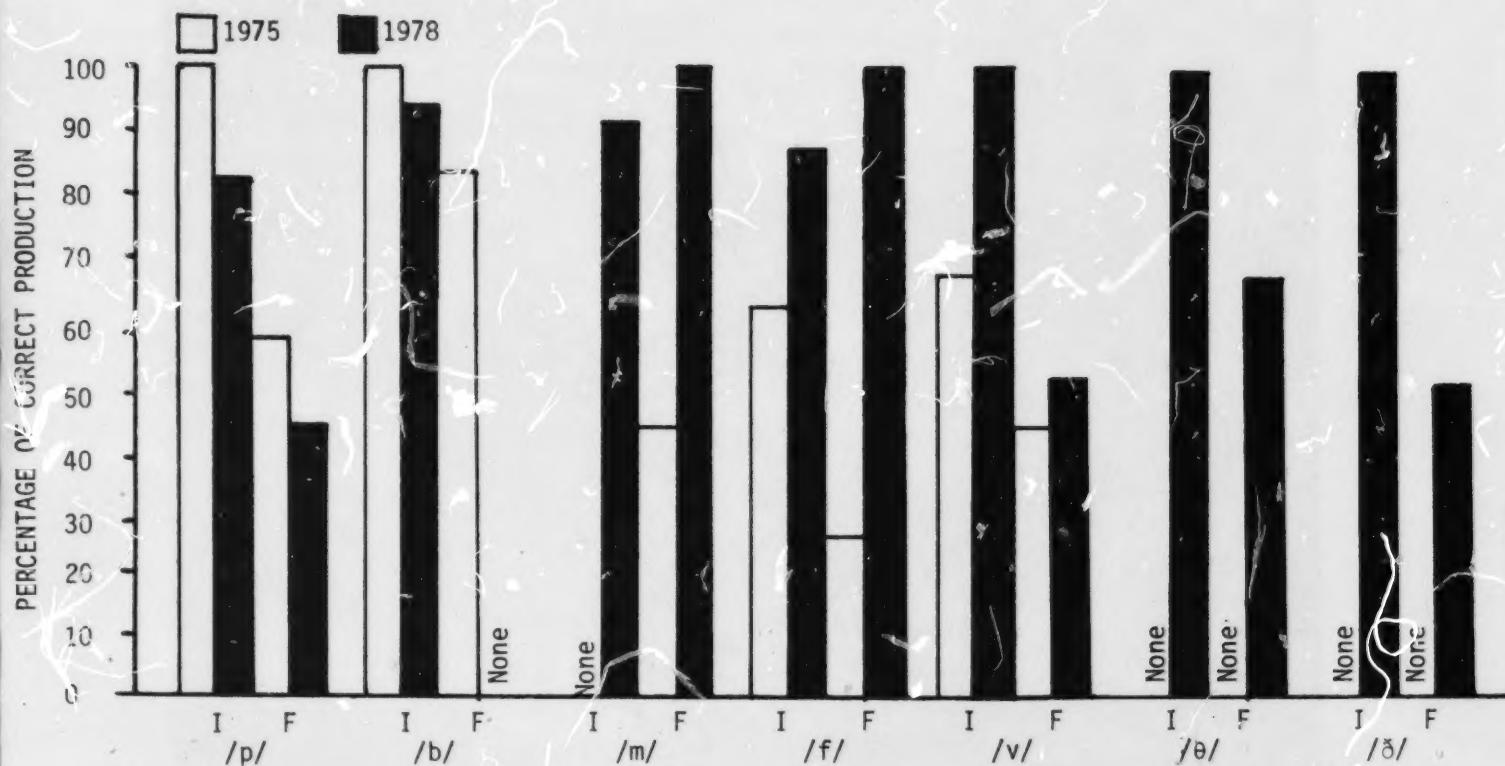
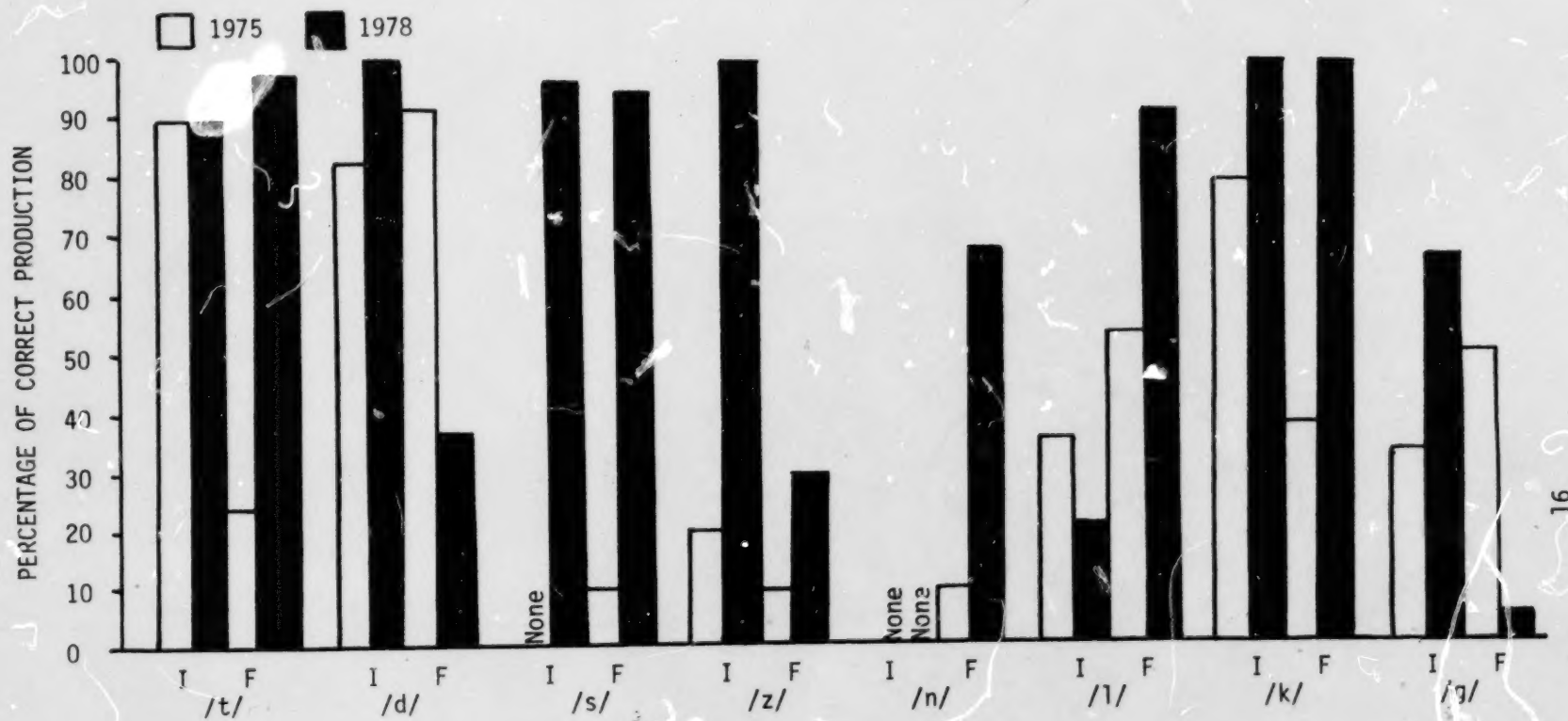


Figure 2. The percentage of correct production of all phonemes present in both word-initial (I) and word-final (F) position. Percentages are presented for 1975 and 1978.



(Figure 2. Continued)